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PATENT ABSTRACTS OF JAPAN

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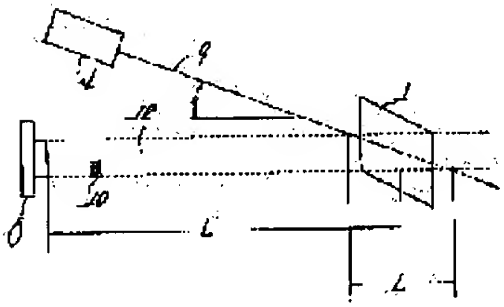
(54) METHOD FOR MEASURING MOVING AMOUNT OF OBJECT TO BE MEASURED IN FRONT/REAR DIRECTION WITH USING LASER LIGHT

(57)Abstract:

PROBLEM TO BE SOLVED: To measure the moving amount of an object to be measured in a forward/ rearward direction, by interposing a light-shielding object at a middle point of a CCD camera and the object to be measured and within a view field of the CCD camera.

SOLUTION: A laser light 9 is projected from a laser oscillator 4 to an object 1 to be measured and a speckle pattern is photographed by a CCD camera 5. A light- shielding article 10 is interposed at a middle point of the camera 5 and the object 1 to be measured and within a view field of the camera 5. As a result, a blank area caused by the light-shielding article 10 is formed in the speckle pattern drawn in a reflecting image zone of an area caught by the camera 5 where the laser light is cast. The movement of the blank area in the image zone of the speckle pattern is detected as a marker, optically recognized and recognized moving pixels are processed/operated, whereby a measuring value is output and displayed. A moving state of the object 1 to be measured in a forward/rearward direction is thus detected. If the object 1 to be measured moves within a measuring range,



the blank area moves in a right/left direction or up/down direction from a measurement start position in accordance with the movement of the object 1.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] This invention relates to the measurement method which measures the movement magnitude of the measured object which carries out longitudinal slide movement to a measuring instrument using a laser beam.

[0002]

Background of the Invention] This invention irradiates a laser beam fundamentally at a measured object, by using as an indicator the speckle pattern drawn on the image range of an irradiated region, detects ****** and this optically, and carries out data processing, makes this measured value further, and indicates by the output.

[0003] The speckle pattern which irradiated the laser beam at the measured object and was drawn on the image range of an irradiated region The field relative roughness of an irradiated plane imitates and displays, and the property which shows singularity different the whole image range is used. Install a shading object in the visual field range of the CCD camera of a measured object and a metering device, and the shadow operation by this shading object is made to form, and into a speckle pattern, the phanerosis of the blank part by this shadow operation tends to be carried out, and let movement of this blank region be a measurement value as movement magnitude of a measured object.

[0004]

[Description of the Prior Art] The measurement method to which are in the measurement method by non-contact conventionally, and recognize optically the speckle pattern drawn on the image range of an irradiated region by irradiating a laser beam at a measured object as an indicator, and carry out data processing of this recognition pixel, and it comes to carry out the display output of the count value has Japanese Patent Application No. No. 147079 [six to] in JP,7-110216,A and the Japanese-Patent-Application-No. No. 277438 [five to] row which the same applicant as this patent application did.

[0005]

[Problem(s) to be Solved by the Invention] The range-measurement method to the

measured object by the laser beam irradiated the laser beam at the measured object, and was drawing distance from time until it receives the reflected light.
[0006] However, when it was point-blank range (0-several m) in this method, the velocity of propagation of light was impossible for measurement 400,000km /and early [a second and]. Moreover, the auto focus (size of circle which laser beam draws is measured) method serves as complicated / complicated-ization of optical system, and a precision mechanism is needed.
[0007] The method which draws the distance from the shadow by the shading position of image within the limits to a measured object as a method of solving these technical problems was developed.
[0008] This invention aims at the method which is going to measure the movement magnitude to the direction of distance of the measured object in the front position of a measuring instrument in a laser oscillation machine row.
[0009]
[Means for Solving the Problem] While installing this invention so that it may become the angle of visibility which the illuminating angle of a laser beam and the angle of reflection of the reflected light which irradiate a measured object set up as a means for making the above-mentioned purpose attain, and it may become the visual field range of the CCD camera of a laser oscillation machine and a measuring instrument Are the mid-position of a CCD camera and a measured object, and a shading object is infixed in visual field within the limits of a CCD camera. The blank region by the aforementioned shading object is formed into the speckle pattern drawn on the reflective image range of the laser beam irradiated region where the Leh CCD camera is photographed especially more. Movement of the blank aforementioned [the move state of far and near movement of a measured object] region of image within the limits of a speckle pattern is detected in indicator to a measuring instrument, it recognizes optically, data processing of the move recognition pixel is carried out, and it is made becoming the measurement-size value impossible by the output.
[0010]
[Embodiments of the Invention] As a phase contrast method, this invention attaches a known proper angle to a laser beam and a CCD camera, and installs the shading object with which only a part interrupts the reflected light from a measured object in the front regular position of a CCD camera.
[0011] The shading portion corresponding to the known angle arises in image within the limits with this shading object. In this state, the shading portion of image within the limits moves by getting mixed up the distance to a CCD camera and a measured object. By recognizing this moved position, the distance to a measured object is measurable.
[0012] The fall of precision is caused although the range to a measured object can be extended by narrowing a known angle. Conversely, although the range to a measured object is narrowed by extending an angle, high precision measurement is possible.
[0013] Laser beam VCO and a measuring instrument will fix this invention in a position mutually soon.
[0014] That is, the optical axis of a laser beam and the angle of visibility of the CCD camera in a measuring instrument are set as a certain angle, and the position used as the reflector is made into a measured [virtual] object installation position, and it is made for an opposed face to turn into a reflector.

[0015] It is the mid-position of this reflector and CCD camera, and a shading object is installed in visual field within the limits of this CCD camera.
[0016] **** of the laser beam which makes the aforementioned visual field range cross in the shape of slant with a certain set-up degree of angle of visibility carries out to the point, i.e., the range in which measurement of decussation within the limits of a defendant measurement object is possible, ending [decussation] from a decussation start point to the aforementioned degree of angle of visibility to the optical axis of the visual field range of a CCD camera.
[0017] The speckle pattern which irradiated the laser beam at the measured object in the range in which the aforementioned measurement is possible, and was drawn on the image range of an irradiated region imitates the field relative roughness of an irradiated plane, and a CCD camera is ******** as the reflected light.
[0018] These are in the point which moves within the limits which recognizes a speckle pattern as the reflected light drawn by the degree of laser beam illuminating angle to which the position is being fixed by movement of the direction of distance of a measured object in which a laser beam is reflected, and the visual field range in the CCD camera currently installed in the fixed position.
[0019] And it is the blank region which catching as an indicator produced as a shadow with the aforementioned shading object in the speckle pattern which moves.
[0020] As for this invention, fixing the measured object of each other from the relation between the incident angle as a reflector and angle of reflection to near makes laser beam VCO and a measuring instrument conditions.
[0021] That is, the angle of visibility of the CCD camera in the optical axis and measuring instrument of a laser beam is set as a certain angle, and the position used as the reflector is made into a measured [virtual] object installation position, and it is made for an opposed face to turn into a reflector.
[0022] It is the mid-position of this reflector and CCD camera, and a shading object is installed in visual field within the limits of a CCD camera.
[0023] To the optical axis of the visual field range of a CCD camera, it has a certain set-up degree of angle of visibility, and the laser beam which makes the aforementioned visual field range cross in the shape of slant carries out to the point, i.e., the range in which measurement of decussation within the limits of a measured object is possible, ending [decussation] from a decussation start point to the aforementioned angle of visibility.
[0024] Although the speckle pattern which irradiated the laser beam at the measured object in the range in which the aforementioned measurement is possible, and was drawn on image within the limits of an irradiated region imitates the field relative roughness of an irradiated plane and a CCD camera is a ******** thing as the reflected light, into **** of the reflected light, a "shadow" is formed with the shading object installed in the front position of this CCD camera, and a blank region is formed in the portion which recognizes ****** and this by making a speckle pattern into an image.
[0025] Then, if a measured object moves to aforementioned measurement within the limits, the blank region drawn on the portion recognized as a speckle pattern will move in a longitudinal direction or the vertical direction according to the movement magnitude of a measured object from the position of a measurement start.
[0026] The move state of the blank region of these above should apply to the installation

position of laser beam VCO, or the mode of the laser beam direction of radiation correspondingly to the metering device.
[0027] These are in the point which the speckle pattern drawn moves to recognition within the limits by the visual field range of the CCD camera currently installed in the degree of laser beam illuminating angle to which the position is being fixed, and the fixed position by movement of a measured object in which a laser beam is reflected.
[0028] ********'s is the aforementioned blank region as an indicator in the speckle pattern which moves.
[0029] Each part grade is explained to the measured object row for attaining the method of this invention as a verification machine by using this invention as the preceding paragraph explained with drawing below.
[0030] 1 is a measured object. 2 is the image range of the CCD (charge-coupled-device; Charge CoupledDevice) camera 5. 3 is a speckle pattern which a laser beam is irradiated by the measured object 1 and the laser oscillation machine 4 draws by the split face. 4 is a laser oscillation machine. 5 is a CCD camera. 6 is a A/D (Analg/Digital) converter which changes the analog signal of CCD camera 5 into a digital signal. 7 is an arithmetic unit which computes the upper and lower sides and horizontal movement magnitude by using a speckle pattern 3 as an indicator. 8 is CRT (Cathode Ray Tube display) which views a speckle pattern 3 directly.
[0031] In order to draw the speckle pattern stabilized in the measured object, high brightness, directivity, and the light are used for the laser oscillation machine 4, and it constitutes it from a laser element, a cooling circuit, a drive circuit, and a lens.
[0032] CCD camera 5 is used in order to photograph the speckle pattern drawn on a measured object, it has the function changed into an NTSC signal (analog data), and the interval of a CCD pixel determines the accuracy of measurement of a travel, and a zoom lens may be used in order to expand or reduce to the roughness and fineness which a computer tends to process with the size of a speckle pattern.
[0033] A/D converter 6 has the function to change an analog signal into a digital signal. An NTSC signal is an analog signal. Therefore, since a speckle pattern is stored in a storage element, it is necessary to change into a digital signal. Since a speckle pattern is a group point pattern by light and darkness, it changes a bright point into "1" and binary-ization which sets the scotoma to "0."
[0034] An arithmetic unit 7 stores the move state (speckle pattern) of a measured object in a storage element continuously, and movement of arbitrary light-and-darkness points is calculated at intervals of a CCD pixel (criteria length), and it carries out a display output as numerical information.
[0035] In verification and experiment / examination stage, CRT8 displays a travel on a speckle pattern row on CRT monitor display, and uses it for the purpose of carrying out the visual sense of a pattern and the move state. However, a display output is carried out in a flight model, using a travel as a numeric value with a seven segment drop.
[0036] When the measured object 1 is used as an aluminum board, it is drawing 3 which took a photograph of the speckle pattern which irradiated the laser beam and actually drew it on this aluminum board.
[0037] A laser beam is irradiated at the measured object 1, a speckle pattern 3 is photoed by CCD camera 5, the neutral colors by light and darkness are removed by A/D converter 6, and it changes into two signals, Ming and dark, and enables it to have inputted into the

arithmetic unit 7.
[0038] 9 is a laser beam, in the visual field range of a CCD camera, and L, the measurable range and L' show the distance from CCD camera 5 to the measured object 1, and theta shows [10 / a shading object and 11 / a blank region and 12] the degree of angle of visibility of a laser beam and the optical axis of the visual field range.
[0039] About the relation of the degree theta of angle of visibility of the aforementioned laser beam 9 and the optical axis of the visual field range of CCD camera 5, in an adult case, although the measurable range L becomes narrow, this degree theta of angle of visibility Although the measurement precision of distance L' from CCD camera 5 to the measured object 1 improves, and the measurable range L becomes large when the degree theta of angle of visibility of a laser beam 9 and CCD camera 5 is smallness, the measurement precision of distance L' to the measured object 1 falls.
[0040] It is the optimal as a means for distance L' to the measured object 1 to take the clearance of CCD camera 5 and the laser oscillation machine 4 in size from CCD camera 5 even if the degree theta of angle of visibility is smallness in an adult case, therefore to measure the movement magnitude of the measured object 1 of point-blank range, and is the measuring method which can be called phase contrast method further again.
[0041]
[Effect of the Invention] This invention has the effect which can measure the move use more exact than the near position of a measured object as a phase-contrast method which measures the movement magnitude of the shadow by using a laser beam for measurement of the detailed movement magnitude of a measured object, and installing a measuring instrument in a position where the move direction turns into the direction of distance at a laser-oscillation machine row, and installing a shading object into **** of the reflected light.

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] While installing so that it may become the angle of visibility which the illuminating angle of a laser beam and the angle of reflection of the reflected light which irradiate a measured object set up, and it may become the visual field range of the CCD

camera of a laser oscillation machine and a measuring instrument Are the mid-position of a CCD camera and a measured object, and a shading object is infixed in visual field within the limits of a CCD camera. The blank region by the aforementioned shading object is formed into the speckle pattern drawn on the reflective image range of the laser beam irradiated region where the Leh CCD camera is photographed especially more. Movement of the blank aforementioned [the move state of far and near movement of a measured object] region of image within the limits of a speckle pattern is detected in indicator to a measuring instrument. The movement magnitude measuring method of the cross direction of a measured object which used the laser beam which recognizes optically, carries out data processing of the move recognition pixel, and is characterized by the bird clapper as the measurement-size value is indicated by the output.

[Translation done.]

* NOTICES *

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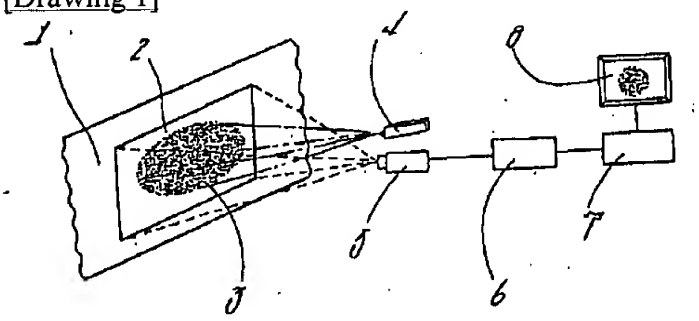
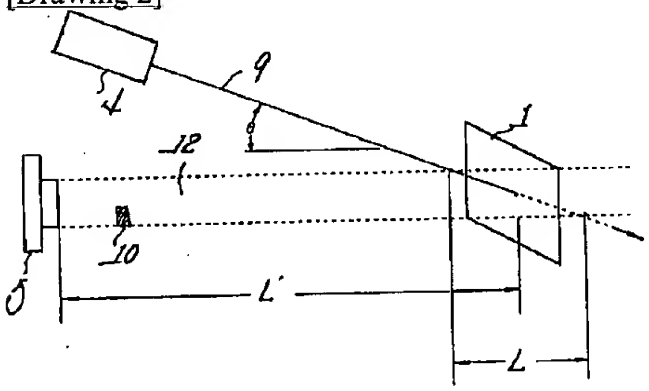
DRAWINGS

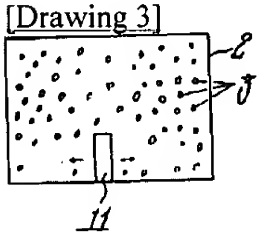
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]